

PLUME TREATED TO NON-DETECT WITHIN 50 DAYS

CASE STUDY:

Grid Treatment Using PersulfOx
and PlumeStop Results in Complete
Reduction of BTEX, TPH-G and MTBE
at Compliance Wells





Overview

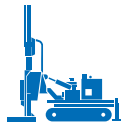
PersulfOx and PlumeStop Provide a Rapid Approach to Treat BTEX, TPH-G and MTBE at Active Gas Station



Thorough DVT program helped to create a unique design for effectively treating the contaminant plume



Cost-effective design and application



Single Application Event



The remedial approach successfully treated a 200 ft. long dissolved phase hydrocarbon plume within the first 50 days

An active gas station in Nebraska was adversely impacted by a dissolved-phase, hydrocarbon plume. The contaminant plume occurred as a result of an underground storage tank release in the mid-1980's. Multiple remedial methods were implemented, including a high-vacuum extraction system, but the groundwater concentrations remained above closure levels.

REGENESIS conducted a thorough and innovative Design Verification Testing (DVT) program prior to remediation in order to ensure an effective remedial design. They used the DVT to produce a design which fit the precise needs of the site as well as the client's budget.

PersulfOx was used to treat the high concentrations of petroleum hydrocarbons at the source and mid-plume areas while PlumeStop was injected to treat the distal plume. The remedial agent was applied using a direct-push application method and was completed in a single event. The treatment was successful in reducing the concentrations of BTEX, TPH-G, and MTBE to non-detect levels. The consultant continued to monitor the groundwater trends until the Nebraska Department of Environment and Energy (NDEE) granted the site closure status. The on-site gas station has remained open for business.

Background

Uniquely Challenging Site Conditions



The treatment site is an active gas station in Nebraska with a dissolved-phase, hydrocarbon contaminant plume. The plume originated from an underground storage tank release in the mid-1980's. Although multiple remedial efforts were attempted, each was unsuccessful and groundwater concentrations remained significantly above closure levels.

REGENESIS began this remediation project with a DVT in order to fill in data gaps, appropriately characterize the site, and ensure an effective remedial design.





Timeline

PersulfOx and PlumeStop Provide a Cost-Effective Approach to Treat BTEX and TPH-G at Former Gas Station



- **September-October 2015**

Design Verification Testing (DVT) conducted



- **October 2015**

Injection events take place



- **October-December 2017**

Post-injection monitoring performed



- **July 2018**

NDEE grants site-closure status

Treatment

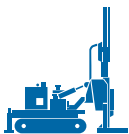
Design Verification Testing

Soil Boring Tests



The soil boring tests involved implementing soil settling tubes at 1 ft. intervals to analyze the soil grain size. This helped to identify the permeable zones within the treatment area. REGENESIS also conducted soil penetrometer tests in 1 ft. intervals to test for compressive strength. The soil samples were analyzed from above and below the water table. This sampling allowed REGENESIS to obtain accurate and up-to-date soil borings which informed the remedial design.

Clear Water Injection Test



This test documented the soil's capability to accept designed injection volumes. The results confirmed that both top-down and bottom-up injections were needed.

The soil borings enabled REGENESIS to delineate the plume boundaries as well as identify the preferred pathway for treatment. The results from these tests showed that there were high TPH-G levels downgradient. These tests helped identify the contaminant transport zones and also provided the necessary information for REGENESIS to determine the correct injection tooling methodology based on the site's geology.

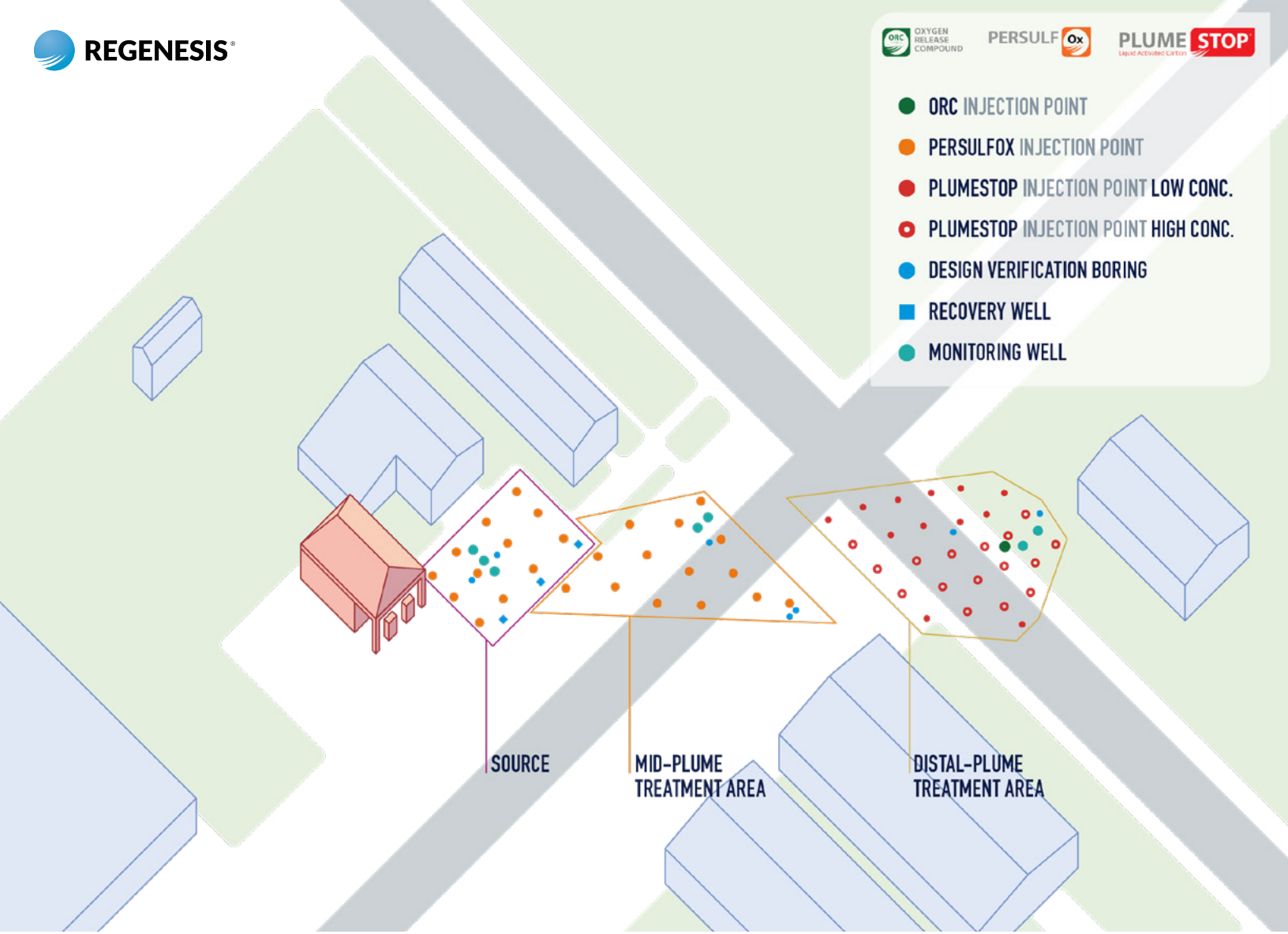
DVT Results



Prior to the DVT, there were concerns about the high residual mass areas and intervals. The DVT allowed REGENESIS to mitigate these concerns by shifting the product delivery concentrations to target high mass areas and by increasing the injection volume for targeted intervals to attain better coverage. Additionally, there were concerns about the soil makeup because it consisted of alternating sand, silt, and clay layers. The Clear Water Injection Test confirmed that utilizing both a top-down and a bottom-up injection approach would ensure successful delivery of the remedial amendment despite a challenging soil composition.



- **ORC INJECTION POINT**
- **PERSULFOX INJECTION POINT**
- **PLUMESTOP INJECTION POINT LOW CONC.**
- **PLUMESTOP INJECTION POINT HIGH CONC.**
- **DESIGN VERIFICATION BORING**
- **RECOVERY WELL**
- **MONITORING WELL**



Treatment Application Process

Applied Quantities:

10,000 Pounds of PlumeStop
4,959 Pounds of PersulfOx
55 Pounds of ORC Advanced

The design involved using PersulfOx to treat the higher concentrations of petroleum hydrocarbons at the source and mid-plume areas. The distal plume area was treated with PlumeStop. The proposed quantities of PlumeStop and PersulfOx were successfully applied within the targeted treatment areas and depths using a direct-push application method. ORC Advanced was applied only at MW-7 as the final step in the application process. The application was completed in a single event.

Technology Used

PlumeStop, PersulfOx and ORC Advanced



PlumeStop® Liquid Activated Carbon™ is an innovative groundwater remediation technology designed to address the challenges of excessive time and end-point uncertainty in the *in situ* remediation of groundwater contaminants. PlumeStop is composed of very fine particles of activated carbon (1-2µm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix binding to the aquifer matrix, rapidly removing contaminants from groundwater, allowing for permanent contaminant biodegradation to proceed.



PersulfOx is an advanced *in situ* chemical oxidation (ISCO) reagent that destroys organic contaminants found in groundwater and soil through abiotic chemical oxidation reactions. It is an all-in-one product with a built-in catalyst which activates the sodium persulfate component and generates contaminant-destroying free radicals without the costly and potentially hazardous addition of a separate activator. The patented catalyst enhances the oxidative destruction of both petroleum hydrocarbons and chlorinated contaminants in the subsurface.



ORC Advanced® provides controlled oxygen release for enhanced aerobic biodegradation. Applying ORC Advanced allows for decreased time to site closure by accelerating degradation rates up to 100 times faster than with natural degradation. A single application can support enhanced degradation for up to 12 months, and offers minimal site disturbance with no permanent or emplaced aboveground equipment, piping, tanks, or power sources. ORC Advanced is simple and easy to apply and monitor, offering a variety of available application methods (direct-push, fixed well, or excavation).

Introducing PetroFix, a Dual-Functioning, Activated Carbon Remedial Technology Specifically for Treating Petroleum Hydrocarbons

Since the completion of this project, REGENESIS has introduced a new cutting-edge technology specifically designed to treat sites with petroleum hydrocarbon impacts. PetroFix™, a cost-effective, dual-functioning activated carbon solution, is designed to remediate petroleum spills and provide immediate results for gas station and UST sites. This safe and effective technology works with the PetroFix Design Assistant™, an online design tool that enables users to individually tailor their site designs and self-apply PetroFix. For more information visit www.petrofix.com





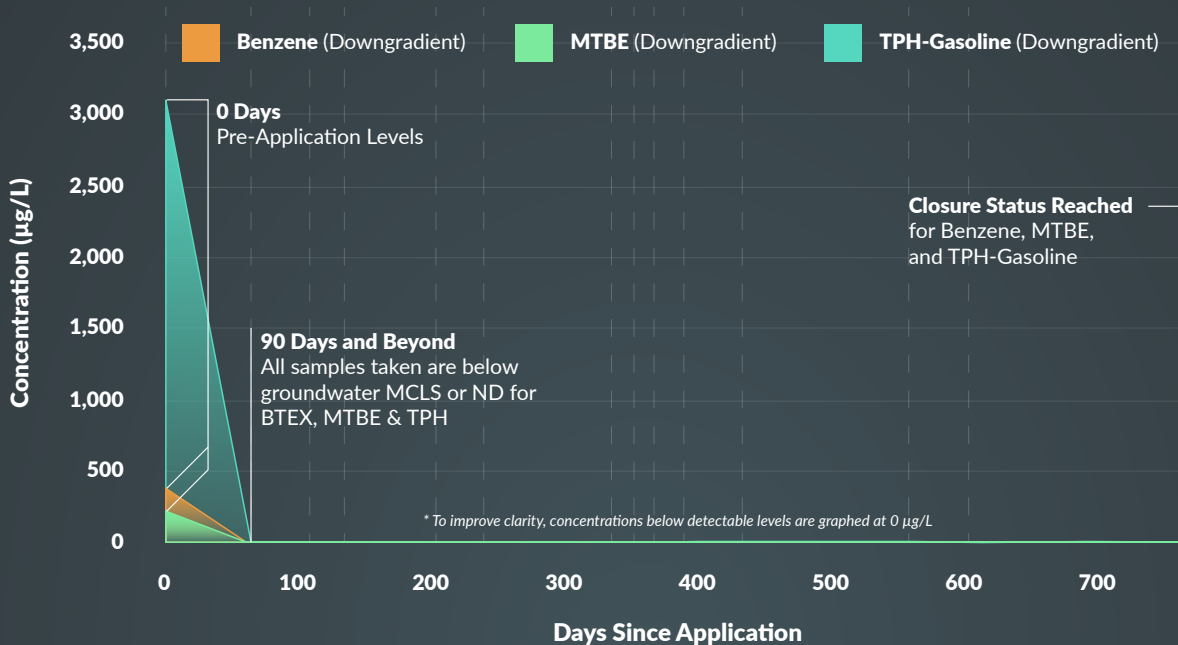
Results

Combined Remedy Approach Treats Plume Within 50 Days

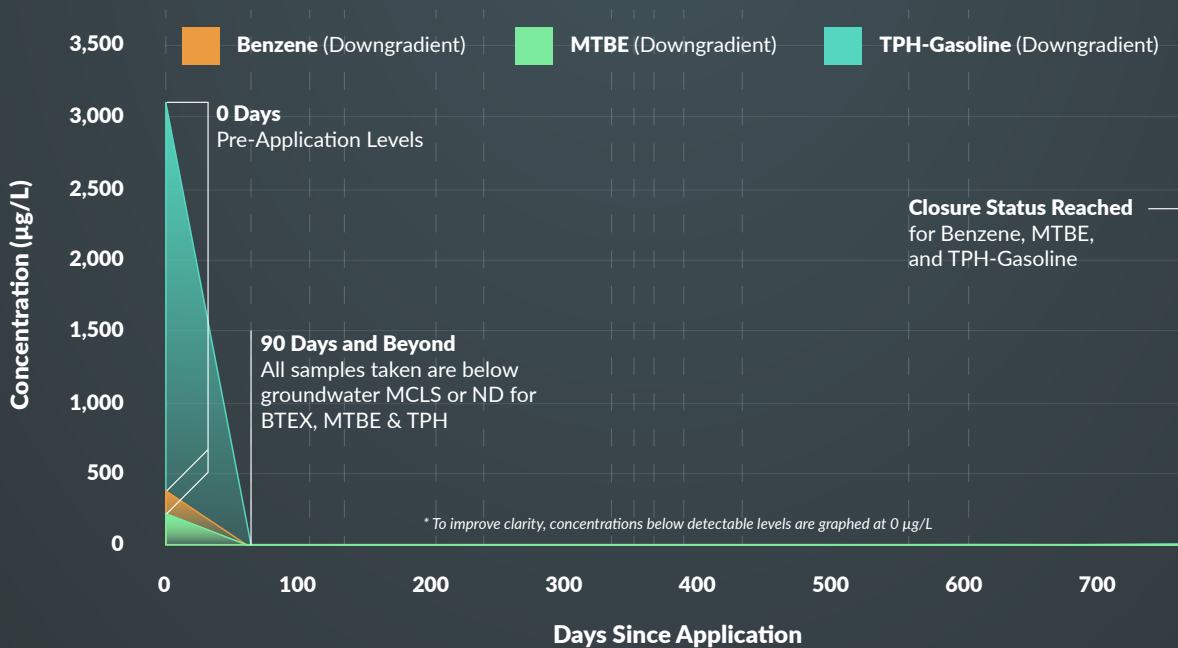


The remedial approach successfully treated a 200 ft. long dissolved phase hydrocarbon plume within the first 50 days. The combination of PersulfOx and PlumeStop quickly and effectively provided the mass reduction needed at the source, along with an adsorptive downgradient barrier. The downgradient treatment showed exceptional performance by preventing plume expansion and by reducing concentrations of BTEX, TPH-G, and MTBE to non-detect. Results allowed the environmental consultant to request and receive closure. Post-application rounds of groundwater sampling have been performed at the site and have shown non-detect levels of TPH-G for over two years. The consultant continued to monitor groundwater trends until the site received closure status in 2018.

TPH-Gasoline, MTBE & Benzene Concentrations Downgradient Monitoring Well (MW 7D)



TPH-Gasoline, MTBE & Benzene Concentrations Downgradient Monitoring Well (MW 7S)





The Consultant About Benesch

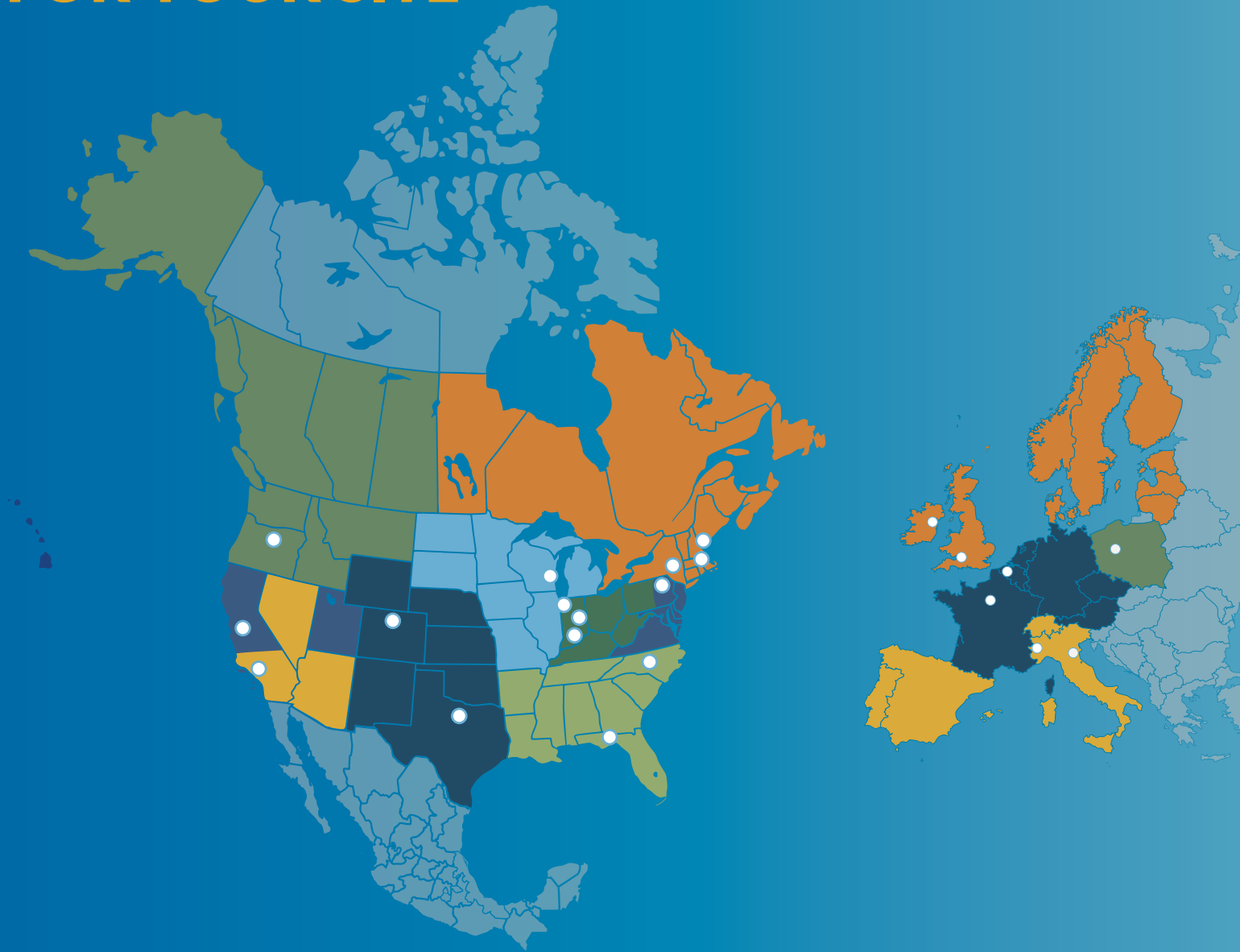


Benesch is a unique kind of professional services firm – we are large enough to handle our clients' most complex and challenging assignments, but nimble enough to offer an exceptional level of customer service. We make our client's number one priority, our priority as well – overall project success.

Our services range from initial planning and feasibility studies through to construction management. We have designed complex highway interchanges, new commuter railway systems as well as major river bridges. We've planned multi-use recreation centers; hospital and educational complexes; and miles of trails and greenway space. We have inspected thousands of highway and railroad bridges; overseen the construction of interstate corridors; and managed the renovations of train stations, airport facilities, schools and intermodal rail yards.

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WE'RE READY TO HELP YOU FIND THE RIGHT SOLUTION FOR YOUR SITE



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